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NOTE

Characters Differentiating Male from Female *Anoplophora glabripennis* (Motschulsky) (Coleoptera: Cerambycidae)

The Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky) (Cerambycidae: Lamiinae) is native to China but was first discovered in North America in Brooklyn in 1996 (Cavey et al. 1998). This beetle is well known as a major pest of hardwoods in China and is able to kill healthy trees, usually after several generations of repeated attacks (Lingafelter and Hoebeke 2002). Since 1996, *A. glabripennis* has been found in Manhattan and surrounding areas of New York City, Long Island, and New Jersey and numerous areas in and around Chicago. In 2003, trees infested with *A. glabripennis* were found in Toronto. Since 1996, this beetle has also been intercepted in numerous ports and warehouses and was also found infesting trees in Austria in 2001 (Lingafelter and Hoebeke 2002). Eradication efforts have successfully decreased the numbers of beetle-attacked trees in many infested areas but new infestations are still being found. Whenever adult *A. glabripennis* are found, it can be difficult to determine sexes in the field because no quantitative morphological features have been reported that readily differentiate males from females. Our laboratory has maintained a quarantine colony of *A. glabripennis* since 1998, and, although we regularly work with adult *A. glabripennis,* it still can be difficult to differentiate males from females. It is important to simplify making this distinction both for field-collected and laboratory-reared individuals. Therefore, several of the most obvious sexually dimorphic characteristics were measured to develop a scheme for differentiating sexes.

Anoplophora glabripennis used for this study were initially obtained from China and Chicago, and a colony has been reared in the USDA, ARS quarantine facility in Ithaca, New York. Rearing methods are described in Dubois et al. (2002), but most of the reared beetles no longer require a chill period to develop to adult. Adults that eclosed and hardened from late September through early December 2003 were randomly chosen for this study. We differentiated males from females by placing pairs of individuals assumed to be opposite sexes together and occurrence of copulation was used to confirm gender. In seven instances when characters were intermediate and beetles did not readily begin mating, sex was determined by dissection to observe internal reproductive structures.

Characters chosen for quantification were based on the most readily visible or easily measured features potentially differing between males and females. All individuals were weighed after hardening and before being fed twigs. The length of an antenna, beginning at the base of the scape, the length of the insect and the width of the anterior end of the elytra were measured in mm. Because individuals varied in length and so did antennae, the ratio between antennal length and body length was calculated. Log-transformed measurements were analyzed using Student's *t*-test (SAS 1999).

All variables measured differed between males and females although for all variables ranges overlapped (Table 1). Due to the great variability, all characters except the ratio of antennal length:body length are of little value for sexing beetles. For example, although females were generally larger in weight, length and width, some males were just as long and wide as fe-

Table 1. Measurements of *Anoplophora glabripennis* adults. Females, n = 59; males, n = 73.

	Mean[a]	SE	Range
Weight (mg)			
Females	67.3 a	2.3	37.9–125.4
Males	49.7 b	1.9	24.4–128.1
Body length (cm)			
Females	2.50 a	0.03	2.1–3.0
Males	2.17 b	0.03	1.8–3.1
Anterior elytral width (cm)			
Females	0.82 a	0.01	0.6–1.1
Males	0.69 b	0.01	0.5–1.0
Antennal length (cm)			
Females	3.49 b	0.03	2.9–4.1
Males	3.94 a	0.05	3.3–5.4
Antennal length : body length ratio			
Females	1.40 b	0.01	1.22–1.77
Males	1.82 a	0.01	1.62–2.10

[a] Within each type of character, means followed by different letters are significantly different ($p < 0.05$).

males and could weigh just as much. The external morphological features measured with the least overlap were antennal length and the ratio of antennal length:body length. Although the ranges of these characters varied for each sex and there was still overlap between sexes, overlap was least for the ratio. While the female antennae were usually less than 1.5 times the body length, male antennae were usually closer to 2 times the body length. For the individuals collected with antennal length: body length ratios that overlapped between male and female ranges, 10 of the 11 were males.

For individuals collected with antennal lengths that were close to 1.5 times the body length, it was difficult to know with certainty whether the beetle was male or female. In these instances, magnification can be used to look at the ventral side of the small terminal antennomere, which is annulated with white in females. In males, this annulation is mostly missing so that the ventral side of the terminal antennomere is predominantly black. However, dissection of specimens is suggested for a definitive answer because sclerotized reproductive structures give a definite sexual identity (Fig 1). The features most easily seen were the sclerotized male aedeagus near the apex of the abdomen and the ovipositor complex of the female that extends much of the length within the abdomen.

In summary, although no external morphological feature always resulted in correct determination of sex, the ratio of antennal length to body length provided the closest prediction. Male antennae were often nearly twice the length of the body whereas female antennae were often less than 1.5 times the body length. It is characteristic of many cerambycid species for males to have longer antennae than females. In some species the elongate antennae are spread by males as they walk on bark, thus improving chances of contacting a female when antennae are longer, suggesting a reason for this observed sexual dimorphism (Hanks 1999).

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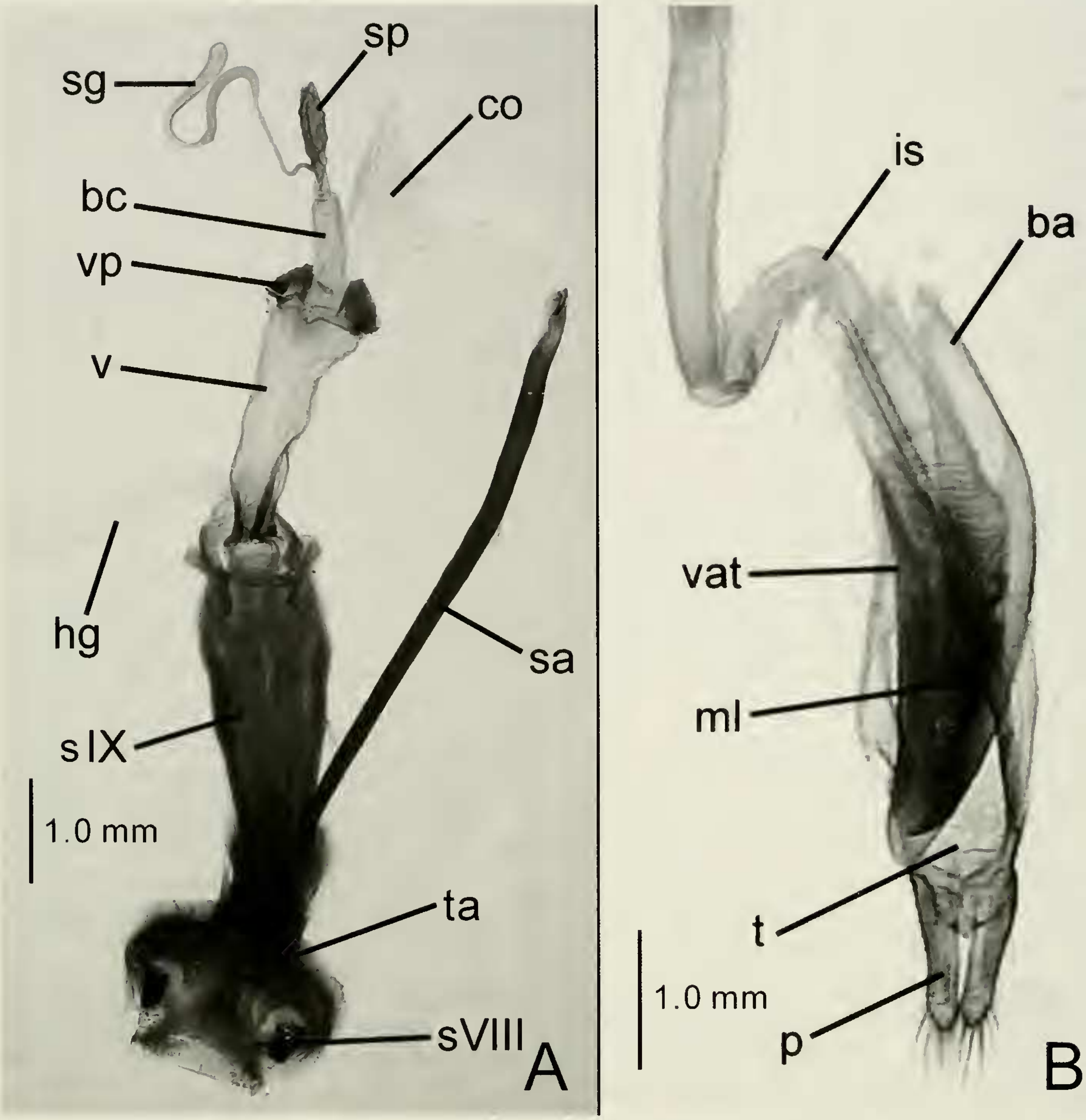

Fig. 1. Internal sclerotized reproductive structures of male and female *Anoplophora glabripennis*. A, Female, ventral view: bc, bursa copulatrix; co, common oviduct; hg, hindgut; sa, sternal apodeme; sg, spermathecal gland; sp, spermatheca; sVIII, sternite 8; ta, tergal apodeme; v, vagina; vp, vaginal plaque; sIX, segment 9. B, Male, ventral view: ba, basal apophysis; is, internal sac; ml, median lobe; p, paramere; t, tegmen; vat, ventral apophysis of tegmen (after Hernández 2000). For additional figures of male and female reproductive structures see Lingafelter and Hoebeke (2002).

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